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microspore being chiefly those of *G. africanum*. The inflorescence is described and also the details of spermatogenesis from the mother cell to the microspore, the reduced number of chromosomes being 12. Great interest attaches to the male gametophyte of *Gnetum*, but the present account does not clear it up. At pollination, three free nuclei were observed in the pollen grain, which "are probably to be identified as one prothallial, one vegetative (tube), and one generative." Since LOTSY has figured three free nuclei in the pollen tube of *Gnetum Gnemon*, which were obviously a tube nucleus and two male cells, the free "prothallial nucleus" in the pollen grain is open to doubt. One would like to be sure whether *Gnetum* has eliminated prothallial tissue or not. The author says that "the germination of the microspore and the structure of the pollen grain point to a much closer degree of affinity with *Welwitschia* than with *Ephedra*," a conclusion which all other structures confirm.

Miss GORDON[8] has discovered ray tracheids, both marginal and interspersed, in old stem wood of *Sequoia sempervirens*. Since the wood of this form is primitive enough in features to suggest its comparison with root wood, the presence of ray tracheids is especially interesting.

WIELAND[9] has published an interesting account of *Williamsonia*, a genus which he has done so much to elucidate. A few years ago a problematical genus, it has now emerged clearly as a prominent Mesozoic group. An account is given of its discovery, its structure, and its phylogenetic connections. Its great range in habit, its variations in the structure of the strobilus, its variable foliage, all suggest wide relationships, and among these suggested relationships WIELAND sees emphasized his contention that the angiosperms have been derived from the Bennettitales.

The same author,[10] in continuing his studies on the trunks of *Cycadeoidea*, has discovered that some of the supposed young strobili are mature ones of reduced type. This incidentally disturbs some of the previous conclusions as to relationships among the species of *Cycadeoidea*, and especially extends our knowledge as to the range of variation in the structure of the strobilus. These reduced or simplified forms of course are more suggestive of the structure of the angiosperm flower.—J. M. C.

Inheritance of doubleness in stocks.—Doubleness in stocks (*Matthiola*) presents one of the most complicated cases of inheritance yet thoroughly studied, but Miss SAUNDERS[11] has developed a scheme which allows a consistent and orderly presentation of most of the facts brought to light by extensive cultures, and by means of which the results to be secured from any particular mating is capable of prediction with a fair degree of accuracy. Double stocks are totally sterile and must always be derived from singles, either self-fertilized or crossed with other singles. Single stocks are of two kinds with respect to their relation to doubleness, namely, "*no-d*-singles" which breed true to singleness when selfed or crossed with others of their own kind, and "*d*-singles" which when similarly bred always produce both singles and doubles, the doubles being generally in excess of the singles. Reciprocal crosses between *d*-singles and *no-d*-singles give unlike results, owing apparently to a difference in the genotypic constitution of eggs and sperms in the *d*-singles, the eggs being of two sorts while the sperms are all equal. Doubleness is recessive and disappears in the F_1, but when the *d*-single is the seed-parent the F_1 singles are of two sorts, some breeding true to singleness, others producing both singles and doubles. When the *d*-single is the pollen-parent, the F_1 singles are all of one kind and all give both singles and doubles in F_2. The ratios of singles to doubles in the pure-bred *d*-single race have always been suggestively near 7:9, thus indicating that the difference between singles and doubles involves two genes instead of one.

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[8] GORDON, MARJORIE, Ray tracheids in *Sequoia sempervirens*. New Phytol. **11**:1–7. *figs. 7.* 1912.

[9] WIELAND, G. R., On the Williamsonian tribe. Amer. Jour. Sci. **32**:433–466. *figs. 18.* 1911.

[10] WIELAND, G. R., A study of some American fossil cycads. Part VI. On the smaller flower-buds of *Cycadeoidea*. Amer. Jour. Sci. **33**:73–91. *figs. 11.* 1912.

[11] SAUNDERS, Miss E. R., Further experiments on the inheritance of "doubleness" and other characters in stocks. Jour. Genetics **1**:303–376. *pls. 2. figs. 2.* 1911.

Miss SAUNDERS assumes that singleness is due to the presence of two factors X and Y, the absence of one or both of these resulting in doubleness. If these two factors were independent, the expected ratio would be 9 singles to 7 doubles, but if they are coupled according to the scheme discovered in sweet peas, etc., $n-1:1:1:n-1$, the doubles would be in excess of the singles as observed. The experimental results accord well with this assumption, and make it probable that the coupling is of the form 15:1:1:15, though possibly 7:1:1:7. The peculiar feature in stocks, however, as compared with the coupling in sweet peas, is the fact that neither X nor Y are carried by the pollen, and the coupling can show itself only in the constitution of the eggs. The crosses with *no-d*-singles resulted in an unexpectedly small number of doubles in F_2, owing, as proved by further breeding, to the fact that in the *no-d*-single race singleness is not produced by the joint action of X and Y, but of a similarly coupled pair X' and Y'. To further complicate the situation, there occurs a "sulfur-white" *d*-single race in which the plastid-color is also "eversporting" in a manner quite similar to doubleness, the pure-bred progenies always consisting of whites and creams as well as doubles and singles, the singles being all white, the doubles mostly cream but also sometimes white. The white plastids are assumed to be due to a factor W which is borne by only a part of the eggs and by none of the sperms. Moreover W is coupled with one of the factors for singleness, either X or Y. Although in the pure *d*-single strains X, Y, and W are carried only by the eggs, crosses between *d*-singles and *no-d*-singles of different plastid-color produced heterozygous F_1 plants in which both pollen and eggs carried the coupled series of genes.

In an appendix the author shows that the increase in proportion of doubles derivable from old seed is due to the greater longevity of the seeds which lack X and Y, and not to any change in the genotypic nature of any single seed. She also tried to separate singles and doubles on the basis of seed-characters, but was able to do this only in the sulfur-white race, and then not by the character for doubleness, but by the white or cream plastid-color, which as stated above proved to be coupled with one of the factors for singleness. Ten-week stocks are much branched and the Brompton stocks unbranched. The unbranched condition is recessive, but the ratio is somewhat modified because typically unbranched plants will develop some branches when the terminal bud is injured. Notes are also appended regarding the inheritance of several sap-colors, rose, lilac, terra-cotta, carmine, and crimson.—GEO. H. SHULL.

Biology and taxonomy of Gymnosporangium.—A monograph treating of *Gymnosporangium* both in its biological and its taxonomic aspects is the outcome of several years of experimental and observational work on that genus by KERN.[12] The work is divided into two parts, the first dealing with the biology and the second with the taxonomy of the genus.

In Part I the biology of the genus is discussed under the following general heads: Introduction (including the life history, general characteristics, and nuclear phenomena), distribution and relationships, experimental investigations of life histories, and pathological and economic importance. Particular attention is given to the geographical distribution of the species with reference to the distribution of their hosts. The main facts are arranged in convenient tables. The forms associated with the two sections of *Juniperus* present the most interesting features in regard to their distribution. The species which occur on the section *Sabina* belong either exclusively to the western or exclusively to the eastern hemisphere, while of those occurring on species of the section *Oxycedrus* some are common to both hemispheres and others are limited to one hemisphere. These facts lead the author to the conclusion that the forms found on the older section (*Oxycedrus*), some of whose species are distributed over all the continents of the northern hemisphere, were distributed with their hosts "during a geological period when the land conditions permitted migrations between the northern continents." The author supposes that the section *Sabina* has developed from the section *Oxycedrus* since the continents have become isolated, therefore "we would not expect to find the same species, either of hosts or fungi, indigenous in North America and in the Old World; and this, indeed, is the case." This view of course implies the independent origin of species of the section *Sabina* in the two hemispheres.

Regarding the limited geographical distribution of species of *Gymnosporangium* in cases where both the hosts have a wider distribution, no satis-

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[12] KERN, FRANK DUNN, A biologic and taxonomic study of the genus *Gymnosporangium*. Bull. N.Y. Bot. Gard. **7**:392–494. 1911.